Allison Transmission®

Mechanic's Tips

700 Series With Hydraulic Controls

MT1366EN

Mechanic's Tips

2006 APRIL

MT1366EN

Allison Transmission

700 Series With Hydraulic Controls

HT 740, HT 740FS, HT 747
HT 754CR
HT 750DR (DB)
CT, CLT, CLBT 750/754(DB)

Allison Transmission

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NOTES

TRADEMARK USAGE

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- TranSynd™ is a trademark of Castrol Ltd.
- DEXRON® is a registered trademark of the General Motors Corporation.
- Viton® is a registered trademark of DuPont Corporation.

WARNINGS, CAUTIONS, NOTES

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions described in this handbook. It is, however, important to understand that these warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Allison Transmission has not undertaken any such broad evaluation. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods selected.

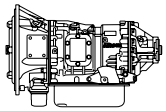
Proper service and repair is important to the safe, reliable operation of the equipment. The service procedures recommended by Allison Transmission and described in this handbook are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

The following three types of headings are used in this manual to attract your attention.

WARNING: A warning is used when an operating procedure, practice, etc., if not correctly followed, could result in personal injury or loss of life.

CAUTION: A caution is used when an operating procedure, practice, etc., if not strictly observed, could result in damage to or destruction of equipment.

NOTE: A note is used when an operating procedure, practice, etc., is essential to highlight.



INTRODUCTION

Section I

1–1. ABOUT THIS MANUAL

This handbook is a mechanic's reference for removing, installing, and maintaining the HT 700(DB) and C(LB)T 700(DB) Series Automatic Transmissions. The features of the transmission and vehicle involved in removal and installation procedures are discussed. The information presented will help the mechanic to remove, install, and maintain the transmission in a manner that assures satisfactory operation and long service life.

Six overall photographs of the HT 700 Series, CLBT 700 Series, and the CLBT 700(DB) Series with transfer gear housing (dropbox) are on the following pages. Each photograph shows the external features and check points discussed throughout this book. Use these photos as a reference. For additional detailed information, refer to HT Service Manual SM1270EN or CL(B)T 700 Series Service Manual SM1314EN, and CLT 750 Preventive Maintenance—Oil Field Applications PM1772EN.

Unless specifically indicated otherwise, this handbook refers to all 700 Series on-highway transmissions. The differences between the various transmissions are explained as required.

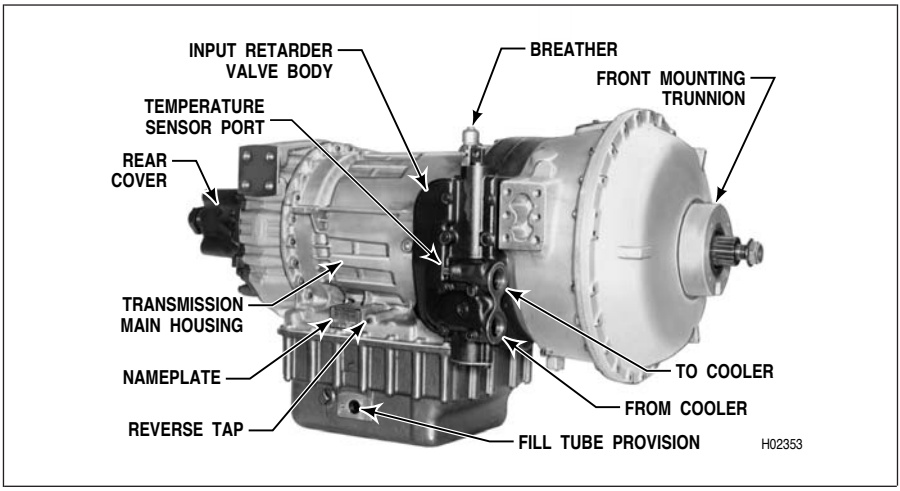


Figure 1–1. CLBT 754 (Remote Mount) Transmission—Right-Front

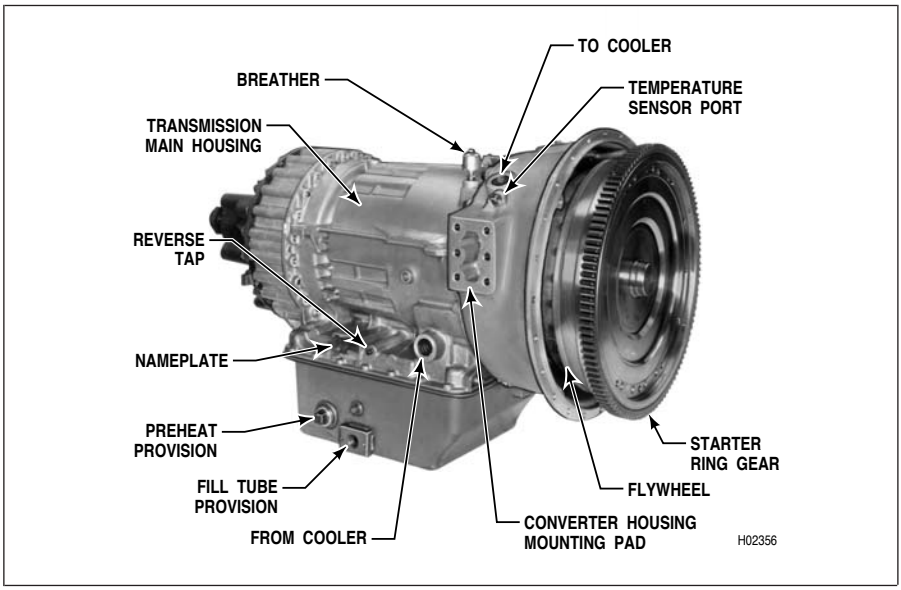


Figure 1–2. HT 754CR Transmission—Right-Front

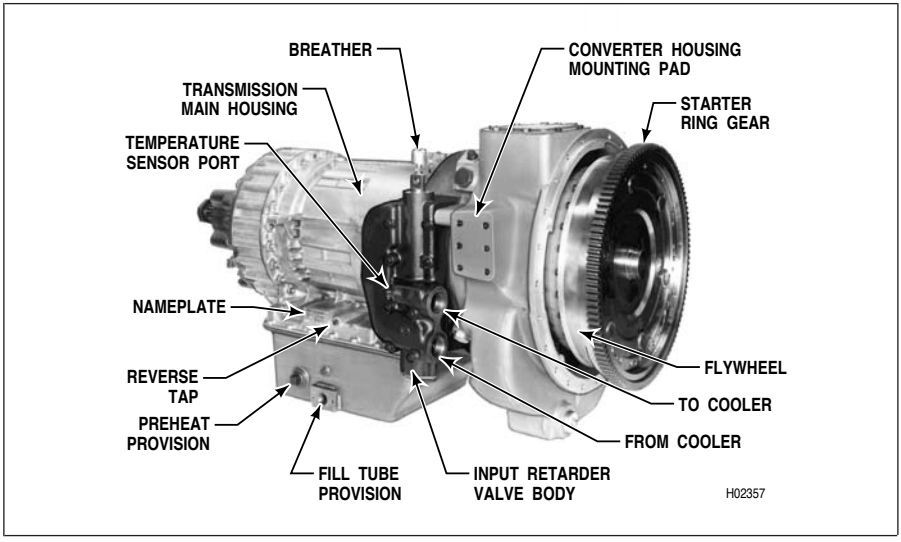


Figure 1–3. HT 750DR Transmission—Right-Front (With Input Retarder and Engine-driven PTO Provision)

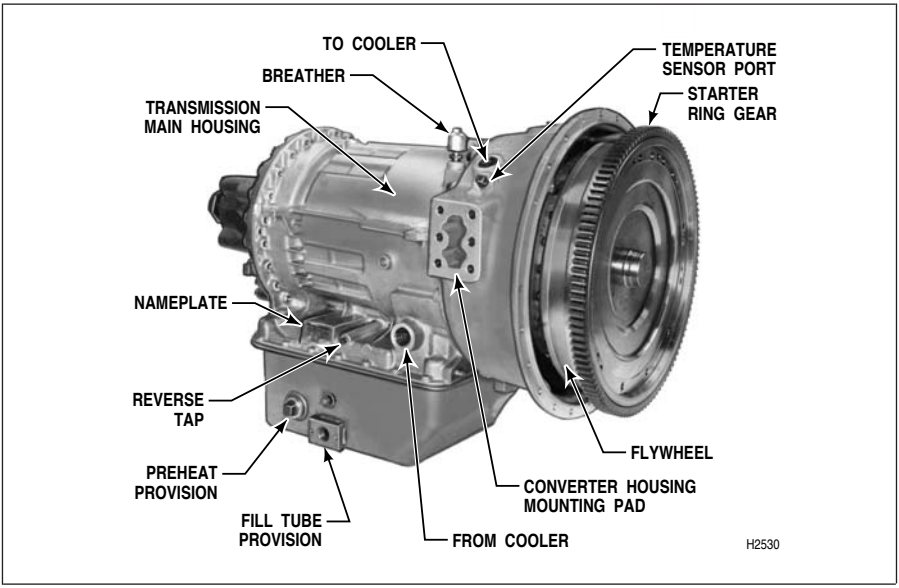


Figure 1–4. HT 740 Transmission—Right-Front

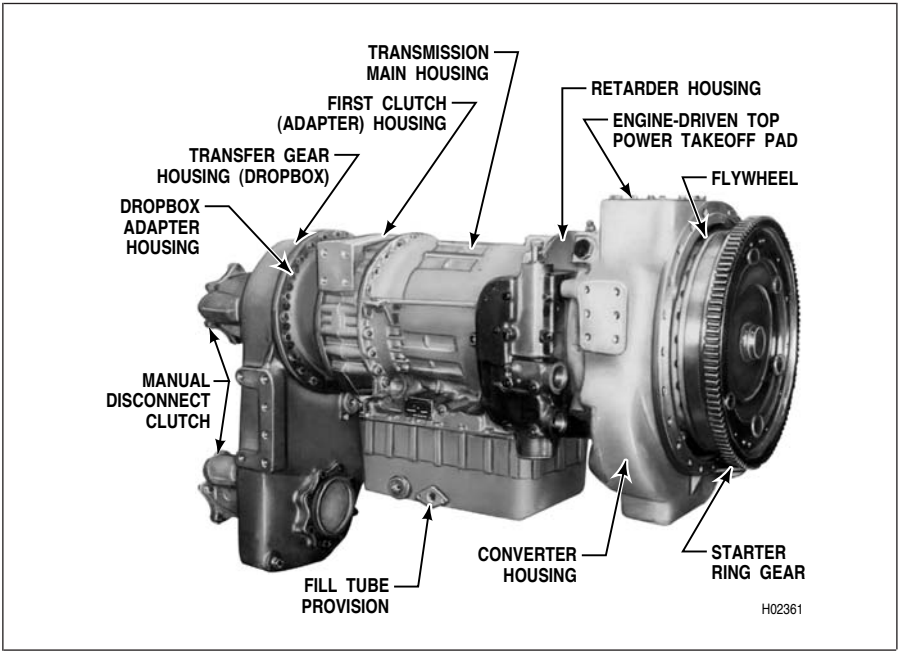


Figure 1–5. CLBT 754DB (Direct Mount) Transmission—Right-Front

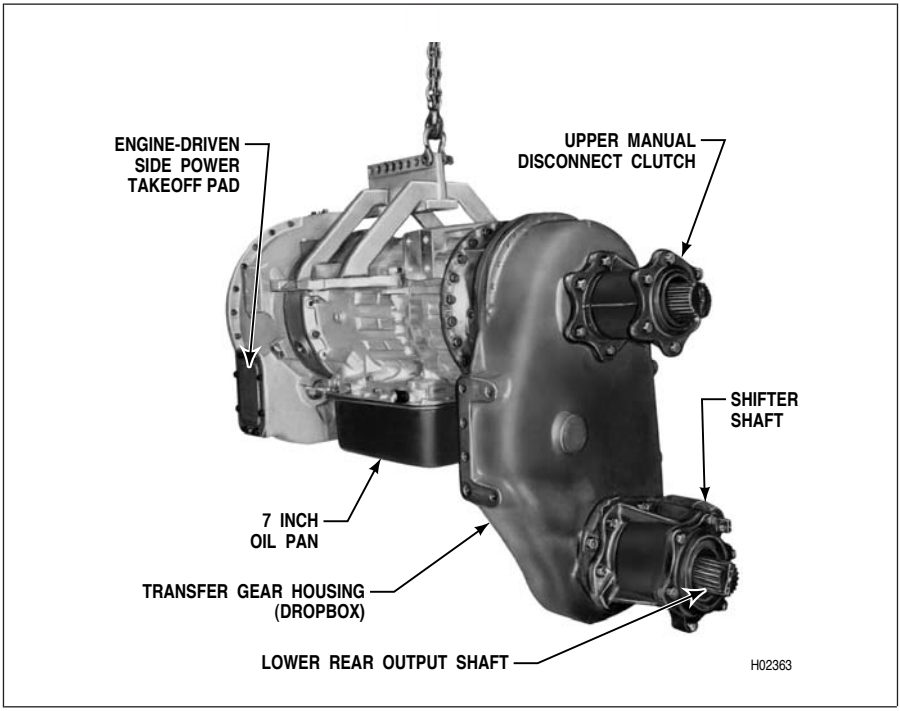
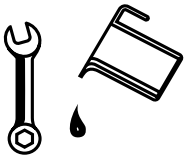


Figure 1–6. CLBT 754DB Transmission—Left-Rear



PREVENTIVE MAINTENANCE

Section II

2–1. PERIODIC INSPECTION AND CARE

Clean and inspect the exterior of the transmission at regular intervals. The severity of service and operating conditions will determine the frequency of such inspections. Inspect the transmission for loose bolts, fluid leaks, or damaged or loose hydraulic lines. Fluid leaks require immediate attention.

Modulator cable linkage at the engine fuel lever and shift selector linkage must be kept:

- Clean
- Properly adjusted
- Lubricated.

2–2. IMPORTANCE OF PROPER TRANSMISSION FLUID LEVEL

The transmission fluid cools, lubricates, and transmits hydraulic power. It is important that the proper fluid level be maintained at all times. If the fluid level is too low, the converter and clutches will not receive an adequate supply of fluid. If the level is too high, the fluid will aerate, the transmission will overheat, and fluid may be expelled through the breather or dipstick tube.

2–3. AERATED FLUID

Aeration changes the viscosity and color of the transmission fluid to a thin milky liquid and adversely affects transmission performance. The primary causes of aeration are:

- Improper fluid
  - — Not enough fluid in the sump
  - — Too much fluid in the sump
- A defective or missing sealring on the intake pipe of the internal filter.
- Leaking air control system introducing air into transmission.

A high fluid level (too much fluid) will cause the clutches to be partially immersed in the sump fluid. Rotation of the clutches churns the fluid causing it to become aerated. The aerated fluid can also cause overheating.

2–4. FLUID LEVEL TEST PROCEDURES

WARNING: Take the following precautions so that unexpected, possible sudden vehicle movement is avoided. Whenever it becomes necessary to leave the vehicle, even momentarily, while the engine is running, place the transmission shift selector in **N** (Neutral), set the parking brake and/or emergency brakes and chock the wheels.

a. Refill After Rebuild Or Overhaul.

- After overhaul or rebuild, the system, including all external plumbing and components such as filters and heat exchanger, **must be refilled**. Dropbox models have to be refilled in both the main transmission section and the dropbox section.

NOTE: The transmission sump and dropbox have independent fluid systems and may require different fluids. Refer to Section 2–6, Automatic Transmission Fluid Recommendations, for the type of fluid required in the transmission and dropbox.

- The initial running of the engine after overhaul will cause a rapid drawdown of the transmission fluid level. Determine the fluid level several times during the first few minutes of operation and add fluid as needed to maintain the level within the **COLD RUN** band.
- Make an accurate fluid level determination after the fluid level has stabilized and the fluid is hot—160–200°F (71–93°C). Refer to Paragraph 2–4c for proper fluid level determination procedures.

b. Fluid Level and Dipstick.

- Figures 2–1 through 2–3 illustrate the fluid levels relative to the $4^1/_2$, 6, 7, and $8^1/_2$ inch deep oil pans. These fluid levels are referenced from the top of the oil pan or the pan to transmission housing splitline.

NOTE: The calibration procedure explained below is applicable to the 7 and $8^1/_2$ inch deep oil pan. The same procedure is applicable to the $4^1/_2$ and 6 inch deep oil pan except use the dimensions shown in Figure 2–1 and Figure 2–2, respectively.

CAUTION: The **COLD RUN** band level (Figures 2–1 through 2–4) is an approximate dimension to be established by the OEM/Customer at installation. An exact **HOT RUN** band dimension and fluid level should be established prior to the **COLD RUN** dimension and fluid level. A **HOT RUN** fluid level determine is required for proper operating fluid level.

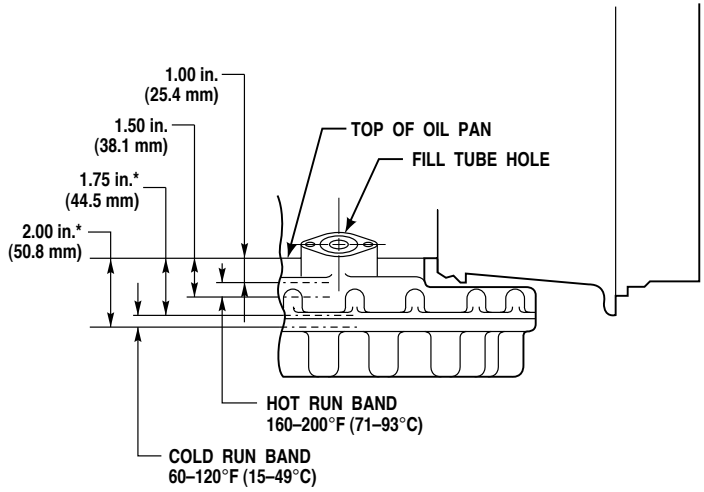


Figure 2–1. Fluid Level ($4^1/_2$ Inch Deep Oil Pan)

- To calibrate the new dipstick, strike a mark on the side of the fluid fill tube (that has been installed) to correspond with the top of transmission oil pan, referenced in Figure 2–3.
- Position the new dipstick down along the outside of the fill tube, holding the top even with the top of the fill tube (where it would rest if installed into the tube). Follow the contour of the fill tube with the dipstick down to the mark previously scribed on the side of the fill tube representing the top of the oil pan Mark the dipstick.
- Now, measure down 2.5 inches (64 mm) below the top of the pan and scribe a line across the dipstick (dipstick may not be vertical). This will be the top line of the **HOT RUN** band as illustrated in Figure 2–3.

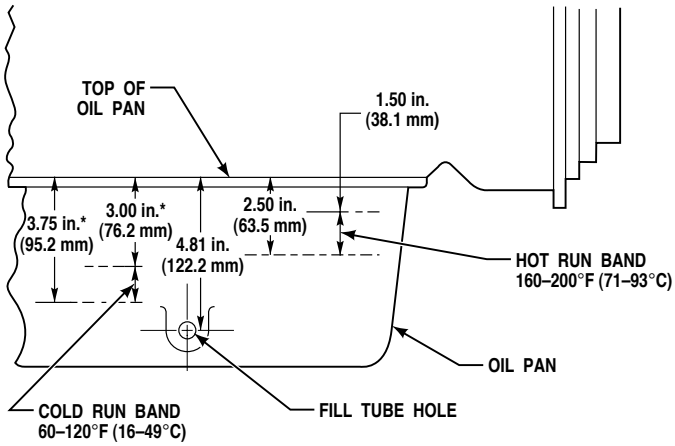


Figure 2–2. Fluid Level (6 Inch Deep Oil Pan)

- At a point 1.0 inch (25 mm) below this scribed line, scribe another line across the dipstick; this represents the bottom of the **HOT RUN** band and the top of the **COLD RUN** band.
- Measure down 1.25 inches (32 mm) and scribe the bottom line for the **COLD RUN** band.
- Add transmission fluid to the transmission through the fill tube opening after dipstick calibration is completed. Be sure to use proper transmission fluid and fluid containers as discussed in Sections 2–5 and 2–6. Refer to Table 2–1 for approximate transmission fluid capacity.

c. Fluid Level Test.

WARNING: To help avoid personal injury or property damage caused by sudden and unexpected vehicle movement, **do not determine** the fluid level until you:

1. Put the transmission into **N** (Neutral).
2. Apply the parking brake and emergency brakes and make sure they are properly engaged.
3. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

- Add transmission fluid to the transmission through the fill tube opening after dipstick calibration is completed. Be sure to use proper transmission fluid and fluid containers as discussed in Sections 2–5 and 2–6. Refer to Table 2–1 for approximate transmission fluid capacity.

Table 2–1. Transmission Fluid Capacity

Application	U.S. Quarts *	Liters*
$4^1/_2$ inch (114 mm) oil pan	34	32
6 inch (152 mm) oil pan	30	28.5
7 inch (178 mm) oil pan	30	28.5
$8^1/_2$ inch (215 mm) oil pan	43	41
Dropbox	2.6	2.5
* Does not include external circuits.		

CAUTION: Do not overfill the dropbox. Overfilling can cause excessive fluid temperatures. If fluid level is above the FULL line, drain fluid as required to bring it to the proper level.

- Clean around the end of the fill tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the transmission because it can cause:
  - — Valves to stick
  - — Undue wear of transmission parts
  - — Passages to clog.
- Determine the fluid level by the following procedures and record any abnormal level on your maintenance records.
- Always measure the fluid level at least twice. Consistency is important in maintaining accuracy. If inconsistent readings persist, inspect the transmission breather and the vent hole in the dipstick fill tube to be sure they are clean and free of debris. The vent hole is located on the underside of the fill tube just below the seal of the dipstick cap.

CAUTION:
- The fluid level rises as sump temperature increases. DO NOT fill above the COLD RUN band if the transmission fluid is below normal operating temperature.
- An unexplained increase in the amount of sump fluid requires immediate attention. A failed rear seal in the engine may be allowing engine oil to enter the transmission sump (on wet converter housing transmissions).

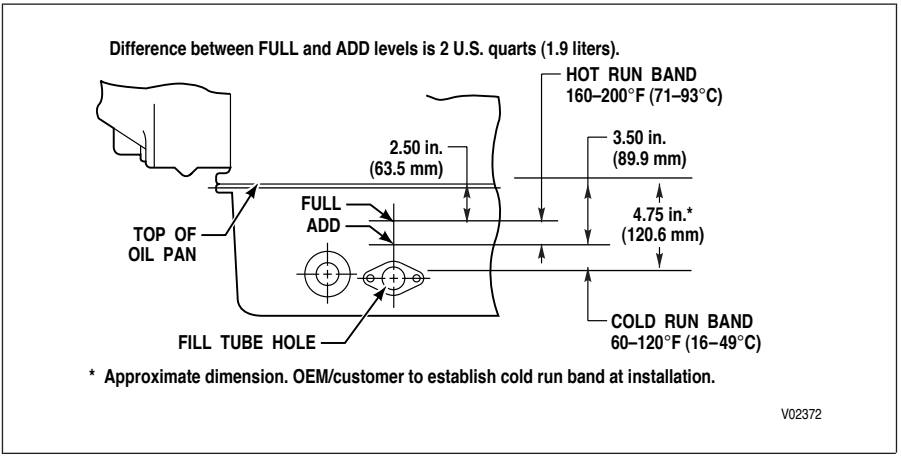


Figure 2–3. Fluid Level (7 and $8^1/_2$ Inch Deep Oil Pan)

d. Cold Test.

NOTE: The only purpose of the cold test is to determine if the transmission has enough fluid to be safely operated until a hot test can be performed.

1. Run the engine for at least one minute. Shift to **D** (Drive) and then to **R** (Reverse) to clear the hydraulic circuits of air. The sump temperature should be between 60–120°F (16–50°C).
2. Park the vehicle on a level surface and shift to **N** (Neutral). Apply the parking and/or emergency brakes and allow the engine to idle (500–800 rpm). Chock the wheels of the vehicle.
3. With the engine running, remove the dipstick from the fill tube, wipe the dipstick clean, and re-insert it into the fill tube, pushing down until it stops.
4. Remove the dipstick again and determine the fluid level. If the fluid is within the **COLD RUN** band (refer to Figure 2–4), the fluid level is satisfactory for operating the transmission until the fluid is hot enough to determine a **HOT RUN** fluid level. If the fluid level is not within the **COLD RUN** band, add or drain fluid as necessary to bring the level to the middle of the **COLD RUN** band.
5. Test for a hot fluid level at the first opportunity after the normal operating sump temperature of 160°F–200°F (71°C–93°C) has been reached.
6. Repeat the test to verify the reading. If the readings are inconsistent, inspect the breather to be sure it is clean and not clogged.

e. Hot Test.

NOTE: The fluid level rises as the fluid temperature increases. The fluid **must be hot** to be sure of an accurate fluid level test.

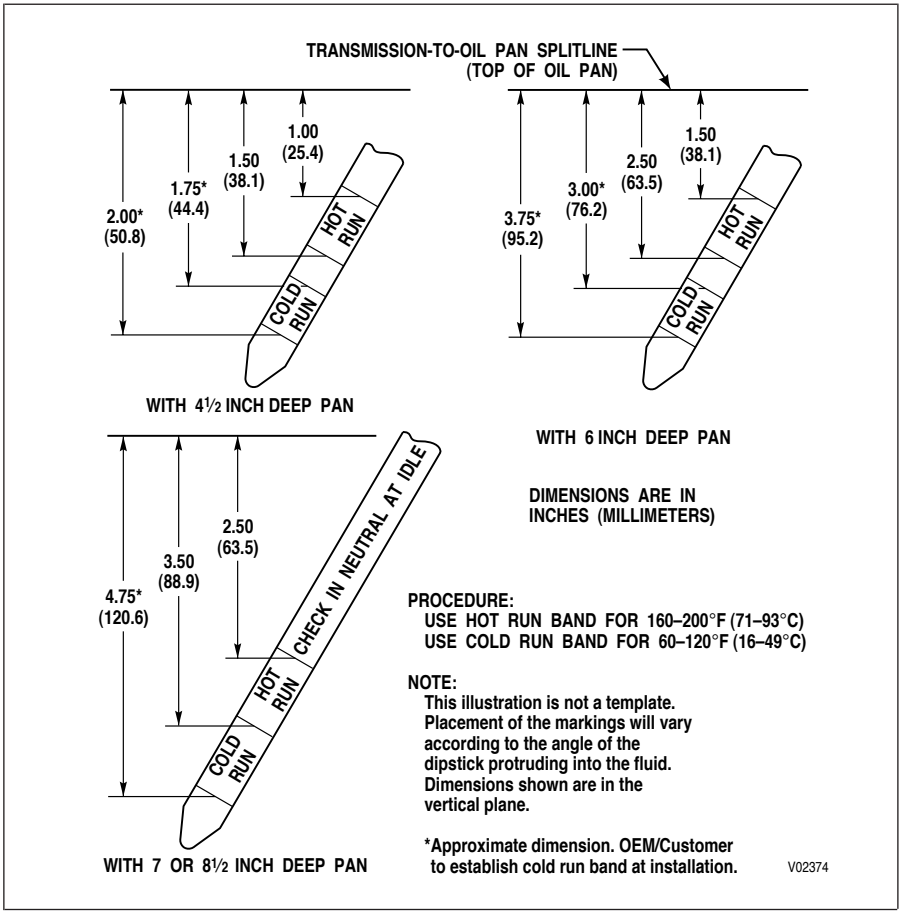


Figure 2–4. Dipstick Markings Locations

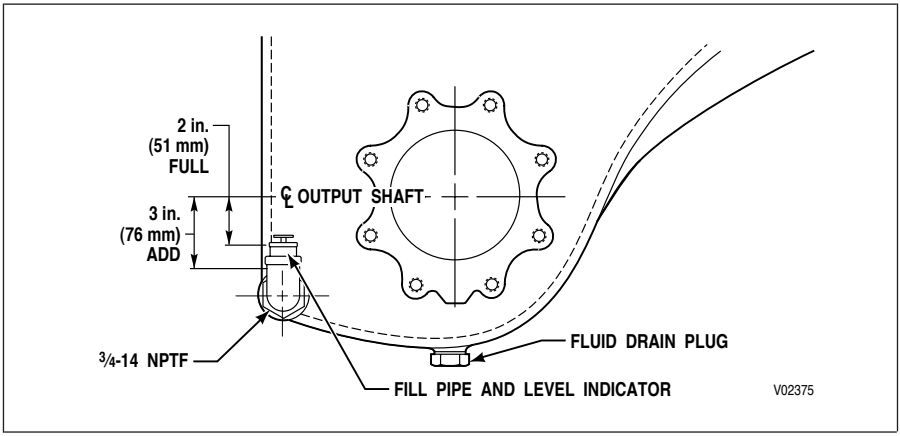


Figure 2–5. Dropbox Fluid Levels (Front View)

1. Drive the vehicle until the transmission fluid reaches normal operating temperature:
    a. 60–200°F (71–93°C) sump temperature
    b. 80–220°F (82–104°C) converter-out temperature
2. Park the vehicle on a level surface and shift to **N** (Neutral). Apply the parking brake and/or emergency brakes and chock the wheels. Allow the engine to idle (500–800 rpm).
3. With the engine running, remove the dipstick, wipe it clean, and re-insert it into the fill tube, pushing down until it stops. Remove the dipstick again and determine the fluid level. The safe operating level is anywhere within the **HOT RUN** band (refer to Figure 2–4) on the dipstick. If the level is not within this band, add or drain fluid as necessary to bring the level to the top of the **HOT RUN** band. DO NOT OVERFILL.
4. Repeat the test to verify the reading. If the readings are inconsistent, inspect the breather to sure it is clean and not clogged.

f. Dropbox Fluid Level Determination.

- With the engine at idle (500–800 rpm), the proper **FULL** and **ADD** fluid levels in the dropbox are shown in refer to Figure 2–5. These levels are on a vertical line through the bottom output shaft.
- The **FULL** and **ADD** marks on the dipstick should coincide with the fluid levels shown in refer to Figure 2–5.
- If fluid level is above the **FULL** line, drain fluid as required to bring it to the proper level. If fluid is below the **ADD** line, add fluid as required to bring it to the proper level.

2–5. KEEPING TRANSMISSION FLUID CLEAN

CAUTION: Containers or fillers that have been used for antifreeze solution or engine coolant MUST NEVER be used for transmission fluid. Antifreeze and coolant solutions contain ethylene glycol which, if put into the transmission, can cause the clutch plates to fail.

Transmission fluid **must be handled** in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Clean around the filler tube before removing the dipstick. Lay the dipstick in a clean place while filling the transmission.

2–6. AUTOMATIC TRANSMISSION FLUID RECOMMENDATIONS

Hydraulic fluids (oils) used in the transmission are important influences on transmission performance, reliability and durability. TranSynd™ or another TES-295 fluid is recommended for all on-highway and general applications. DEXRON®-III can also be used in on-highway or general applications. Type C-4 fluids are recommended for severe-duty and off-highway applications.

Some DEXRON®-III fluids are also qualified as Type C-4 fluids. To be sure the fluid is qualified for use in Allison transmissions, look for a DEXRON®-III or C-4 fluid license or approval number on the container, or consult the lubricant manufacturer. Consult your Allison Transmission dealer or distributor before using other fluid types; fluid types such as Type F, and universal farm fluids may or may not be properly qualified for use in your Allison transmission.

CAUTION: Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.

When choosing the optimum viscosity grade of fluid to use, the following **must be** taken into consideration:

- Duty cycle
- Preheat capabilities
- Geographical location

Table 2–2 lists the minimum fluid temperatures at which the transmission may be safely operated. Preheat with auxiliary heating equipment or by running the vehicle with the transmission in neutral for a minimum of 20 minutes before attempting range operation.

Use only type C-4, Grade SAE 30 transmission fluid in the dropbox.

Table 2–2. Operating Temperature Requirements for Transmission Fluid

	Minimum Operating Temperature	
SAE Viscosity Grade* or Fluid Type	**Fahrenheit**	**Celsius**
0W–20 (Arctic)** or TranSynd™	–22	–30
DEXRON®–III	–13	–25
SAE 10W	–4	–20
15W–40	5	–15
SAE 30	32	0
SAE 40	50	10
* SAE "W" designation means winter weight based on cold temperature properties.		
** "Arctic" as defined by MIL-L-46167B (Ref. SIL 13-TR-90)		

2–7. FLUID TEMPERATURES

If the temperature sensor is located in the converter housing or input retarder valve, the critical temperatures are listed in the converter-out column. If the temperature sensor is located in some other area, refer to the vehicle manual for the critical temperatures. If the maximum fluid temperature is reached, follow this procedure:

- Stop the vehicle and shift the transmission into neutral and operate the engine at 1500 rpm to reduce the transmission fluid temperature
- If the transmission fluid does not cool in approximately 30 seconds, or if it continues to overheat after operation is continued, stop the vehicle and engine and locate the problem.

Operation	Converter-Out
Converter–CLBT 700 Series	275°F (135°C) max
Converter–HT 700 Series	300°F (149°C) max
Retarder–Intermittent	330°F (121°C) max
Lockup	250°F (121°C) max
Normal	180–220°F (82–105°C)

2–8. TRANSMISSION FLUID AND FILTER CHANGE INTERVALS

Filters to be changed include the following:

- Standard main-pressure external filter or high-efficiency main-pressure external filter
- Governor filter
- Suction screen in the oil pan.

NOTE: The governor filter and suction screen in the oil pan should only be changed at transmission overhaul.

a. Transmission Fluid Change.

CAUTION: Transmission fluid and filter change frequency is determined by the severity of transmission service. More frequent changes may be necessary than recommended in the general guidelines when operating conditions created high levels of contamination or overheating.

Table 2–5 is a general guide for fluid and filter change intervals.

Fluid **must be** changed whenever there is evidence of dirt or high temperature indicated by discoloration or change in fluid analysis. Refer to Table 2–4 for applicable fluid analysis oxidation measurement limits.

Table 2–4. Fluid Oxidation Measurement Limits

Measurement	Limit
Viscosity	±25% change from new fluid
Total Acid Number	+3.0* change from new fluid
Solids	2 percent by volume maximum
* mg of potassium hydroxide (KOH) to neutralize a gram of fluid.	

Transmission protection and fluid change intervals can be optimized by the use of fluid analysis. However, filters must be changed at or before recommended intervals.

Consult your local industrial yellow pages for transmission fluid (oil) analysis firms. Use only one analysis firm. Results between firms cannot be accurately compared. Refer to Allison publication GN2055EN, Technician's Guide for Automatic Transmission Fluid, for additional information

b. Standard Main-Pressure External Filter. Change standard main-pressure external filter after the first 5000 miles (8000 km) and thereafter as indicated in Table 2–5.

Table 2–5. Recommended Fluid and Filter Change Intervals

NOTE: Local conditions, severity of operation or duty cycle may require more or less frequent fluid change intervals that differ from the published recommended fluid change intervals of Allison Transmission. Transmission protection and fluid change intervals can be optimized by the use of fluid analysis. **Filters must be changed at or before recommended intervals.**

SEVERE VOCATION**				GENERAL VOCATION***			
	Filters†*				Filters†*		
Fluid†	Main	Internal	Lube/ Auxiliary	Fluid†	Main	Internal	Lube/ Auxiliary
Schedule 1. Non-TranSynd™/Non-TES 295 Fluid							
12,000 Miles (20 000 km) 6 Months 500 Hours	12,000 Miles (20 000 km) 6 Months 500 Hours	Overhaul	12,000 Miles (20 000 km) 6 Months 500 Hours	25,000 Miles (40 000 km) 12 Months 1000 Hours	25,000 Miles (40 000 km) 12 Months 1000 Hours	Overhaul	25,000 Miles (40 000 km) 12 Months 1000 Hours
NOTE: Recommendations in Schedule 2 are based upon the transmission containing 100 percent TranSynd™ or TES 295 fluid. Flushing machines are not recommended or recognized due to variation and inconsistencies with assuring removal of 100 percent of the used fluid.							
Schedule 2. Recommended Fluid and Filter Change Intervals (TranSynd™/TES 295 Fluid							
50,000 Miles (80 000 km) 24 Months 2000 Hours	25,000 Miles (40 000 km) 12 Months 1000 Hours	Overhaul	25,000 Miles (40 000 km) 12 Months 1000 Hours	100,000 Miles (160 000 km) 48 Months 4000 Hours	50,000 Miles (80 000 km) 24 Months 2000 Hours	Overhaul	50,000 Miles (80 000 km) 24 Months 2000 Hours

** **Severe Vocation:** All retarders, On/Off-Highway, Refuse, Transit, and Intercity Coach with duty cycle greater than one stop per mile.

*** **General Vocation:** Intercity Coach with duty cycle less than or equal to one stop per mile and all other vocations.

† Change fluid/filters after recommended mileage, months, or hours have elapsed, whichever occurs first.

†* When an Allison recommended high-efficiency filter is used, the change interval is until the Change Filter light indicates the filter is contaminated or until it has been in used three years, whichever occurs first. High-efficiency filters are only approved for use with AT/MT/HT Series.

c. Suction Filter and Governor Filter. Change the suction and governor filters, located inside the transmission, only at overhaul. Consult the appropriate service manual for detailed replacement procedure.

d. Fluid and Filter Change Procedure.

1. The fluid should be warm when draining. This promotes quicker and better drainage.
2. On earlier models, remove the fill tube from the oil pan and allow the fluid to drain. On later models, remove the drain plug from the rear of the oil pan and allow the fluid to drain. Examine the condition of the fluid as described in Paragraph 2–9.
3. On earlier models, install the filler tube at the side of the pan and tighten the filter tube retainer nut to 90–100 lb ft (112–136 N·m). On later models, install the oil drain plug at the rear of the oil pan and tighten the plug to 15–20 lb ft (20–27 N·m).
4. Remove the dipstick and pour approximately 30 quarts (28.4 liters) of transmission fluid into the transmission through the filler tube. Then determine the fluid level using the procedure described in Paragraph 2–4.

2–9. TRANSMISSION FLUID CONTAMINATION

a. Examine At Fluid Change. At each transmission fluid change, examine the fluid that is drained for evidence of dirt or water. A normal amount of condensation will emulsify in the fluid during operation of the transmission. However, if there is evidence of water, inspect the cooler (heat exchanger) for leakage between the water and fluid areas. Fluid in the water side of the cooler (heat exchanger) is another sign of leakage. This, however, may indicate leakage from the engine oil system.

b. Metal Particles.

CAUTION: If excessive metal contamination has occurred, replace the cooler and all bearings within the transmission.

Metal particles in the transmission fluid or on the magnetic drain plug (except for the minute particles normally trapped in the filter) indicate damage has occurred in the transmission. When these particles are found in the sump, the transmission **must be** disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, cooler, and all other areas where the particles could lodge. During the repair of a major internal failure of a transmission, it should be dismantled into as many serviceable detail parts as possible and thoroughly cleaned. **Do not disassemble the unit just to the problem area.**

c. Water/Coolant Leakage.

NOTE: Cooler water can be contaminated by engine oil. Be sure to locate the actual source of cooler contamination.

The presence of ethylene glycol coolant in the transmission fluid is detrimental to the reliability and durability of the internal components. Contaminated fluid has a deteriorating effect on transmission components (seals, gasket, etc.) and on highly loaded steel parts, such as bearings and gears, due to reduced lubricity of the fluid. Frictional capacity of drive clutch plates can be greatly reduced as a result of surface film or impregnation and the presence of glycol will physically deteriorate clutch plate materials.

If contamination is suspected, obtain a fluid sample when the transmission fluid is at normal operating temperature to be sure a contaminant, if present, is thoroughly dispersed in the fluid being sampled. The analysis of the sample, by the fluid supplier or any qualified laboratory, will provide the degree of contamination and possibly a clue as to its source. A minimal amount of water and glycol may be due to one or all of the following:

- Uncovered oil drum
- Open transmission fill tube
- Glycol from an all-purpose fill container
- Defective transmission oil cooler.

Do not use fluid contaminated by water, regardless of whether it contains glycol, if the water is greater than 0.2 percent by volume of fluid.

CAUTION: If the transmission fluid is contaminated by water, 0.2 percent by volume, or any trace of ethylene glycol, disassemble the transmission and replace the following:

- Seals
- Gaskets
- Clutch plates
- Bearings
- Torque converter
- Components that have rusted
- Solenoids that do not meet resistance specifications

Remove all traces of ethylene glycol and varnish deposits. Failure to follow this procedure decreases transmission reliability and durability.

CAUTION: After flushing the cooler, test the external cooler circuit for restrictions. If circuit pressure drop is above specifications, the cooler has trapped particles and **must be replaced**.

Nelco Company offers a kit that detects the presence of ethylene glycol in transmission fluid. The kit is identified as “GLY-TEK” Test Kit and can be obtained from:

Nelco Company
1047 McKnight Road South
Saint Paul,, MN 55119
(651) 738–2014

Some conditions that may indicate water and/or glycol in the fluid are:

- Rust or pitted transmission parts
- Transmission fluid spewing out of transmission breather
- Transmission fluid in radiator
- Gaskets blistered or wrinkled in uncompressed areas
- Appearance of fluid (presence of water causes a cloudy or gray, pink, or strawberry colored fluid)
- Steam from the breather.

For additional field analysis information, refer to Allison Transmission publication number GN2055EN, Automatic Transmission Fluid Technician’s Guide. Use this publication to review testing methods and limits of water/glycol content.

2–10. AUXILIARY FILTER

If a condition occurs that introduces debris into the transmission hydraulic system, a complete cleanup of the cooler and lines is required.

Because repeated cleaning and flushing may not remove all debris, install an auxiliary filter in the cooler-out circuit (models without an output retarder), or in the lubrication circuit (models with an output retarder). This recommendation applies whether the transmission is overhauled or replaced by a new or rebuilt unit.

If any doubt exists about the cleanup of the cooler, replace the cooler.

The auxiliary filter **must have** at least a 40-micron filter element or finer and a maximum filter pressure drop of 3 psi (kPa) at 15 gpm (57 liters/minute) at 180°F (82°C). The maximum external circuit pressure drop must not exceed 30 psi (207 kPa) at 15 gpm (57 liters/minute) at operating temperature, in drive at full throttle stall. The following auxiliary filters are recommended:

Filter Assembly	Filter Element
Allison 29510921 *	Allison 29510918 *
AC PM 13-16	PF897

Filter Assembly	Filter Element
AC PM 16-1	PF141
FX 11583	HF6520
Fram HP 1-1	HP 1 or AC HD 222
Purolator OF-15C-1	OF-2C-1
Purolator 20–10	PER-20
* High-efficiency filter and element are available from your authorized Allison distributor. Ref: SIL 12-TR-93 (latest revision)	

2–11. BREATHER

The breather is located at the top of the transmission housing. It serves to prevent pressure buildup within the transmission. The breather **must be** kept clean and the passage open. The amount of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the transmission. Spraying steam, water, and/or cleaning solution directly on the breather can force water and cleaning solution into the transmission.

Always use a wrench of the proper size to remove or replace the breather. Pliers or a pipe wrench can crush or damage the stem and produce metal chips which could enter the transmission.

2–12. TRANSMISSION STALL TEST AND NEUTRAL COOL-DOWN

a. Purpose. The stall test provides a method for determining if the malfunction is in the engine or in the transmission when the vehicle powerpack is not performing satisfactorily.

The neutral cool-down procedure uses the two-minute cooling period on the stall test to gather fluid temperature data for troubleshooting reference.

An extremely low stall speed, such as 33 percent of the specified engine stall rpm, during which the engine does not smoke, could indicate a freewheeling stator.

If the engine stall speed conforms to specification, but the transmission fluid overheats, refer to the cool-down procedure. If the fluid does not cool during the two-minute cool-down procedure, a stuck stator could be indicated.

If the engine stall speed conforms to specifications and the cool-down procedure shows that transmission fluid cools properly, refer to the latest version of the troubleshooting manual for further troubleshooting procedures.

b. Transmission Stall Test Procedure. The actual engine stall point (rpm) under load is compared to the established normal speed specified by the engine manufacturer.

NOTE: The engine data for the test is available from the engine manufacturer or from your vehicle dealer or distributor.

1. Connect a tachometer of known accuracy to the engine, and install a temperature probe into the converter-out (to-cooler) line. Bring the transmission to the normal operating converter-out temperature of 180–220°F (82–104°C).

WARNING: When conducting a transmission stall test, the vehicle MUST BE prevented from moving. Apply the parking brake and service brakes, chock the wheels, and take any other steps necessary to keep vehicle from moving. Warn personnel to keep clear of the vehicle and its travel path. Failure to do so can cause serious injury.

CAUTION: Never maintain the stall condition for more than 30 seconds at any one time because of the rapid rise in fluid temperature. Do not let the converter-out fluid temperature exceed 300°F (149°C). Do not rely on converter-out fluid temperature to limit stall duration. During stall conditions, internal temperatures rise much faster than converter-out fluid temperature. If the stall test is repeated, do not let the engine overheat.

2. With the wheels chocked and the parking and service brakes applied, shift to **D** (Drive). Then accelerate the engine to wide-open throttle. Stabilize the converter-out fluid temperature at 255°F (107°C). Record the engine speed.
3. Reduce engine speed to idle and shift to **N** (Neutral).

c. Neutral Cool-Down Test Procedure. The neutral cool-down test procedure determines if the transmission fluid cools following an engine load condition. Perform this test immediately after the engine speed has been recorded in the stall test.

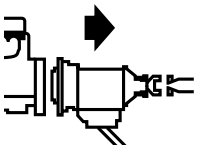
1. Record the converter-out fluid temperature.
2. With the transmission remaining in neutral, run the engine at 1200–1500 rpm for two minutes to cool the fluid.
3. At the end of two minutes, record the converter-out fluid temperature.

d. Results.

NOTE: Environmental conditions, such as ambient temperature, altitude, engine accessory loss variations, etc., affect the power input to the converter. Under such conditions, a stall speed deviation within a range of ±150 rpm from specification can be accepted as within normal range.

If engine stall speed is more than 150 rpm below the stall speed specified by the engine manufacturer, an engine problem is indicated, such as need for tune-up.

If engine stall speed is more than 150 rpm above specification, a transmission problem is indicated, such as slipping clutches, cavitation, or torque converter failure.



REMOVING TRANSMISSION FROM VEHICLE

Section III

3–1. DRAINING TRANSMISSION

Drain the transmission fluid before removing the transmission from the vehicle.

1. Park the vehicle on level ground, shift to **N** (Neutral) and apply the parking or service brake.
2. Start the vehicle engine. Operate the engine until the transmission fluid is warm. Warm fluid will facilitate quicker and better draining.
3. Shut off the vehicle engine and remove the drain plug from the transmission oil pan (disconnect the fill tube on earlier HT 700 Series models). Replace the plug after fluid has drained. Examine the drained fluid for evidence of water or debris that indicates failure of internal components.
4. On dropbox models, remove the drain plug closest to the bottom of the dropbox. Drain the fluid and replace the plug. Inspect the fluid for contamination.
5. Remove the fill tube if it will interfere during transmission removal.
6. Disconnect all other hydraulic lines from the transmission, and allow them to drain. **Cover or plug the lines and openings to keep out dirt.**

3–2. DISCONNECTING CONTROLS

CAUTION: Use of an impact wrench requires a means to hold the selector shaft to prevent internal damage.

1. Disconnect or completely remove all controls from the transmission and position them so they do not interfere with transmission removal.

NOTE: On models with a splined shift selector shaft, mark the transmission shift selector lever with a center punch adjacent to the index mark on the selector shaft before removing the lever, if a mark is not already present on the lever. **Do not use** excessive force to remove the lever. Failure to work the lever carefully from the shaft will cause internal damage.

2. Disconnect all linkage or cables for shifting, shift modulation, hydraulic retarder, output disconnect controls, parking brake, and speedometer. Remove the mechanical modulator control. For earlier models, remove the actuator rod that is free when the modulator is removed (refer to Figure 4–1).
3. Disconnect the power takeoff (PTO) from its driven equipment. Disconnect the PTO controls. Remove the PTO if it will interfere with transmission removal.
4. Disconnect any electrical leads from sensors or other equipment on the transmission.

3–3. UNCOUPLING FROM DRIVELINE, ENGINE, AND VEHICLE

1. Disconnect the vehicle driveline from the transmission output flange or yoke.
2. Disconnect the input drive flange or yoke (remote mounted).
3. Position the propeller shaft to avoid interference with transmission removal.
4. Figure 3–1 shows a typical arrangement for coupling the engine and transmission (engine mounted).

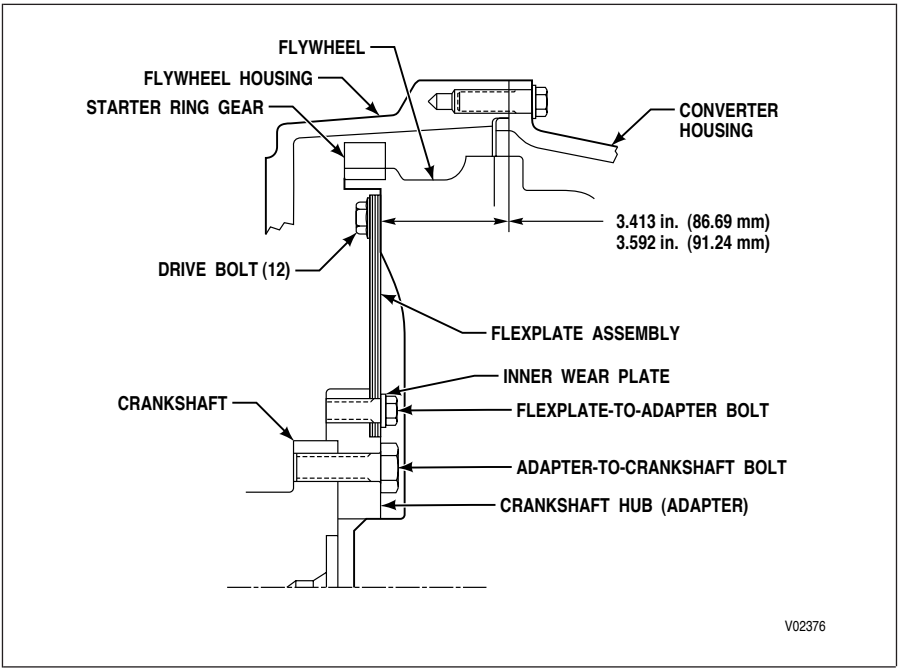


Figure 3–1. Typical Transmission-To-Engine Coupling

5. Remove the drive bolts that secure the flexplate assembly to the flywheel.

3–4. REMOVING MOUNTING BOLTS

1. If transmission mountings support the rear of the engine, place a jack or other support under the engine.
2. Support the transmission securely on a jack, hoist, or other removal equipment.
3. Remove all bolts and supports that attach the transmission to the engine and vehicle.

3–5. REMOVING THE TRANSMISSION

1. Move the transmission away from the engine until completely clear of the engine. Remove the adapter ring and/or gasket (if used).
2. Raise or lower the transmission as required to remove it from the vehicle.

3–6. REMOVING OUTPUT FLANGE OR YOKE

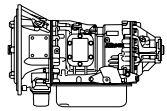
CAUTION: The use of an impact wrench requires a means to hold the flange. Failure to hold the flange can cause internal damage to the transmission.

When replacing the transmission, it may be necessary to transfer input and output flanges or yokes to the replacement transmission. If the flanges or yokes are retained by a large self-locking nut, follow these specific procedures to remove the nut:

1. Before removing the self-locking nut, determine if there are any notches cut into the wrenching flats. If there are five notches, remove the nut and discard.
2. If there are less than five notches or none at all, remove dirt and burrs from the shaft threads. Loosen the nut until there is about $^{1}/_{16}$ inch gap between the nut and flange.
3. Determine the running torque as the nut is being removed. The first time the nut is removed (no notches), running torque must be at least 400 lb in. (45 N·m). Each additional time the nut is removed (one to four notches), running torque **must be** at least 300 lb in. (34 N·m). Discard the nut if it does not meet the running torque limit.

3–7. REBUILD, OVERHAUL INSTRUCTIONS

Refer to the current edition of Service Manual, SM1270EN (HT 700) or SM1314EN (CT 700) for rebuilding or overhauling the transmission.

Section IV	PREPARING TRANSMISSION FOR INSTALLATION	

4–1. INSPECTING FLYWHEEL

a. Bolt Holes.

- Inspect the 12-bolt circle on the front of the flywheel. The $^{1}/_{2}$-20 threads must be undamaged and the holes free of chips or foreign material.
- Inspect the pilot boss (at center of flywheel) for damage or raised metal that would prevent free entry into the hub adapter.
- Inspect the starter ring gear for excessive wear or damage. Check welds that retain the ring gear (where applicable).
- Inspect the transmission mounting flange for gasket remnants, raised metal or dirt.

4–2. INSTALLING OUTPUT FLANGE OR YOKE

a. Output Oil Seal.

- Inspect the rear oil seal for failure or damage. For replacement instructions refer to Service Manual SM1270EN (HT 700 Series) or SM1314EN (CT 700 Series).
- Lubricate the oil seal with high-temperature grease or transmission fluid.
- Inspect the output flange or yoke for damage or wear. The oil seal contact surface **must be** smooth and regular to prevent transmission fluid from leaking past the seal
- Install the parking brake assembly. Tighten the bolts to 180 lb ft (240 N·m).
- Install the output flange or yoke. Rotate the flange during installation to avoid seal lip damage. The brake drum, if it mounts ahead of the flange or yoke, **must be** attached before the flange is installed, and its bolts tightened to the torque recommended by the vehicle manufacturer. Be sure the flange or yoke hub is seated against the transmission rear bearing
- The output flange or yoke on straight-through model transmissions is retained by a large self-locking nut. This nut may be reused up to five times if it meets running torque requirements during removal (refer to Paragraph 3–6).

- Each time the nut is reused, deeply scribe one of the wrenching flats. This will allow the mechanic to determine how many times the nut has been used.
- Inspect the threads on the output shaft and self-locking nut to be sure that they are clean and free of damage. To prevent thread galling and inaccurate torque during nut installation, apply molybdenum disulfide grease or transmission fluid to the threads of the output shaft and nut.

CAUTION: The use of an impact wrench requires a means to hold the flange. Failure to hold the flange can cause internal damage to the transmission.

Install the self-locking nut and tighten it to 600–800 lb ft (814–1085 N·m).

Dropbox models with manual disconnect output clutches use two bolts, shims, and a locking tab to retain the flange and retainer. Refer to Service Manual SM1270EN (HT 700 Series) or SM1314EN (CT 700 Series) for shimming procedure and bolt torque.

If the brake drum mounts behind the flange or yoke, install the drum and attach it with bolts or nuts (as required). Tighten the bolts or nuts to the torque recommended by the vehicle manufacturer.

4–3. INSTALLING INPUT FLANGE (REMOTE-MOUNT MODELS)

1. Inspect the front oil seal for failure or damage. For replacement instructions, refer to Service Manual SM1270EN (HT 700 Series) or SM1314EN (CT 700 Series).
2. Lubricate the oil seal with high-temperature grease or transmission fluid.
3. Inspect the input flange or yoke for damage or wear. The oil seal contact surface **must be** smooth and regular to prevent transmission fluid from leaking past the seal.
4. Install the input flange or yoke. Rotate the flange during installation to avoid seal lip damage. Be sure the flange or yoke is seated against the bearing in the front of the transmission front cover.
5. The input flange or yoke is attached by a large self-locking nut. This nut may be reused up to five times if it meets running torque requirements during removal (refer to Paragraph 3–6).
6. Each time the nut is reused, deeply scribe one of the wrenching flats. This will allow the mechanic to determine how many times the nut has been used.

7. Inspect the threads on the input shaft and self-locking nut to be sure they are clean and free of damage. To prevent thread galling and inaccurate torque during nut installation, apply molybdenum disulfide grease or transmission fluid to the threads of the shaft and nut.

CAUTION: The use of an impact wrench requires a means to hold the flange. Failure to hold the flange can cause internal damage to the transmission.

8. Install the self-locking nut and tighten it to 450–550 lb ft (610–745 N·m).

4–4. INSTALLING SHIFT SELECTOR LEVER

Two types of manual shift selector shafts are currently used: the flatted type and the splined type.

a. Flatted Selector Shafts.

1. For flatted selector shafts, install the flatted selector lever onto the selector shaft. The flats in the lever will seat on the tapered flats on the selector shaft before the lever seats against the shaft shoulder.

CAUTION: Flatted selector shafts that are center-drilled at their outer ends require an M10 x 1.5-6G nut (metric thread). Shafts that are undrilled require a $^{3}/_{8}$-16 nut (standard inch series). Use of the wrong nut will damage both the shaft and the nut.

2. Install the lever retaining nut, finger tight, against the lever.
3. Shift the selector to a position two detent "clicks" away from either end.

CAUTION: Overtightening the nut can damage the shaft and/or lever.

4. Hold the lever and tighten the nut to 15–20 lb ft (20–27 N·m) (refer to Figure 4–1).

b. Splined Selector Shafts.

1. For splined selector shafts, loosen the clamp bolt in the shift selector lever.
2. Locate the punch mark that was put on the outer side of the lever (Paragraph 3–2) when removed.

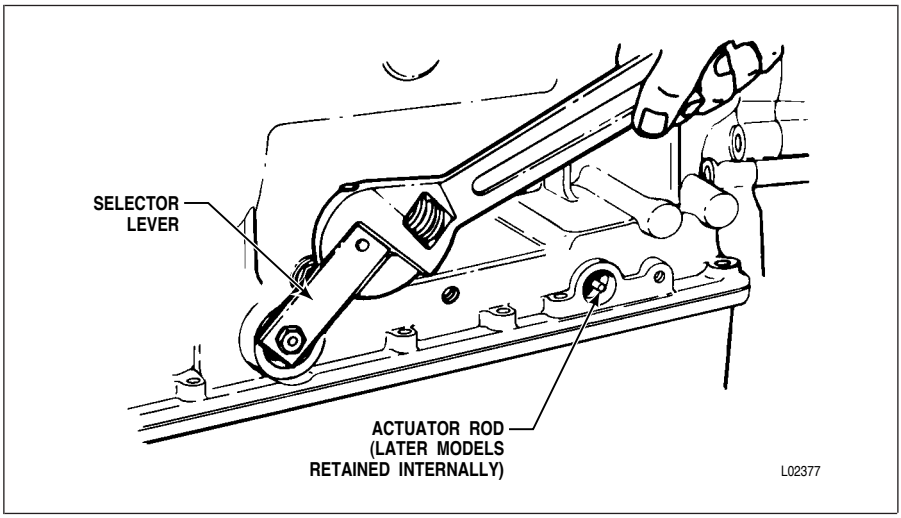


Figure 4–1. Holding Selector Lever For Removal (Installation) Of Nut

CAUTION: Do not drive or force the lever onto the shaft. Internal damage to the transmission might result.

3. Spread the clamp end of the lever, and install the lever so that the punch mark aligns with the index mark on the end of the transmission selector shaft. Push the lever on the shaft until the splines fully engage. To prevent internal damage, do not apply excessive force during lever installation.
4. Tighten the clamp bolt to 15–20 lb ft (20–27 N·m) to attach the lever.

4–5. INSTALLING POWER TAKEOFF (PTO)

Space limitation will determine whether the PTO should be installed before or after the transmission is installed.

- The prescribed backlash for turbine and engine-driven PTO is 0.006–0.029 inch (0.15–0.74 mm).

CAUTION: Cork or other soft gaskets CANNOT BE USED to mount the PTO. Use only shims or gaskets recommended by the PTO manufacturer.

- Establish the proper backlash by selecting the proper thickness shims (gaskets) when mounting the PTO. A PTO that whines is too tight. Gear clatter indicates too much backlash (too loose).

- To be sure of proper installation, locate the PTO unit driven gear (before installation) immediately behind the transmission drive gear. Install two headless guide bolts into the top and bottom of the PTO pad. Install the PTO unit.
- Gear backlash can be measured through the inspection port provided in some PTO housings.
- For a PTO mounted at either the top or side of the converter housing, the prescribed backlash is in addition to that already provided between the drive gear in the transmission and its driving gear at the rear of the torque converter pump. Thus, it is necessary to measure the drive gear-converter pump gear backlash before installing the PTO.
- On PTO assemblies that require pressure lubrication, install the lubrication tube fittings. The lubricating fluid comes from the line returning to the transmission from the oil cooler. Fluid should be directed to the PTO lubrication circuit after passing through a 0.060 inch (1.52 mm) restriction (maximum orifice size permitted is 0.110 inch (2.79 mm) for the engine-driven PTO or 0.032 inch (0.81 mm) restriction for the turbine-driven PTO). This restriction is usually provided in the PTO.

CAUTION: PTO units using transmission main pressure to engage the PTO drive gear must have a positive main pressure shut-off at the solenoid valve when the PTO is not engaged.

4–6. CONNECTING SHIFT MODULATOR CONTROL

Connect all electrical, pneumatic, or vacuum modulator controls after the transmission is put into the vehicle. If using mechanical modulator control, refer to Paragraph 6–9.

4–7. INSTALLING OIL FILL TUBE

If the oil fill tube was removed, install it before the transmission is put into the vehicle, unless its presence will interfere with transmission installation.

1. Install the oil fill tube onto the oil pan boss. If the tube is attached to the oil pan by a nut, tighten the nut to 90–100 lb ft (123–135 N·m); or, for $4^1/_2$ inch pan models, tighten the nut to 40–50 lb ft (54–68 N·m).

CAUTION: Be sure that the proper length bolts are used. Using bolts that are too long may cause cracks (leaks) in the pan.

2. If the tube is attached by bolts, install the oil fill tube and gasket onto the oil pan. Install two $^5/_{16}$-24 bolts with lockwashers into the oil pan boss to attach the tube assembly. Tighten the bolts to 14–18 lb ft (19–24 N·m) for

models with the 6, 7 or $8^1/_2$ inch pan. For models with the $4^1/_2$ inch pan, tighten the bolts to 26–32 lb ft (36–44 N·m).

3. Fasten the upper end of the oil fill tube with brackets and bolts as required.
4. Install the dropbox fill tube or fluid level indicator into the dropbox (refer to Figure 2–5).

4–8. FRONT MOUNTING SPACERS

Later transmissions have a reduced width between the mounting pads on the torque converter housing, and may require spacers between the mounting pads and vehicle frame mounts.

- SAE grade 8, $^5/_8$-11 x $1^3/_4$ inch bolts are required.
- Install two bolts with lockwashers to attach each spacer. Tighten the bolts to 164–192 lb ft (223–260 N·m).

Section V	PREPARING VEHICLE FOR TRANSMISSION INSTALLATION	

5–1. ENGINE, TRANSMISSION ADAPTATION REQUIREMENTS

- To adapt the transmission to a new installation, be sure that it can be properly coupled to the engine. The flexplate assembly and certain engine features must be checked and must be within limits.
- The measuring equipment required includes:

  — 24 inch vernier caliper (Kent-Moore J 26900-25)

  — 2.125–3.500 inch telescoping gauge (Kent-Moore J 26900-25)

  — 2–3 inch outside micrometer (Kent-Moore J 26900-25)

  — Dial indicator and attachments required to mount (base and posts) (Kent-Moore J 26900-25)

  — 18 inch straight edge (The 24 inch vernier caliper can be used as a precision straight edge.)

  — 0–6 inch depth micrometer set

- More detailed information is available in Service Information Letter 60-TR-81 (latest revision), available from Allison distributors or dealers, and on the internet at *www.allisontransmission.com.*
- Measure the flywheel housing bore diameter. Limits: 20.125–20.133 inch (511.18–511.38 mm).
- Measure the flywheel housing bore runout tolerance. Limit: 0.012 inch (0.305 mm) T.I.R. maximum.
- Measure the flywheel housing face runout tolerance. Limit: 0.012 inch (0.305 mm) T.I.R. maximum.
- Measure the crankshaft hub pilot diameter, or, when used, the hub adapter pilot diameter. Limits: 2.437–2.439 inch (61.90–61.95 mm).
- Measure the crankshaft hub face runout tolerance, or, when used, the installed hub adapter face squareness. Limit: 0.0005 inch maximum per inch (0.013 mm per cm) of measured diameter.
- Measure the crankshaft hub pilot eccentricity, or, when used, the installed hub adapter pilot eccentricity. Limit: 0.005 inch (0.13 mm) T.I.R maximum.
- The flatness adjacent to each converter mounting bolt hole measurement is not a required measurement for HT or CT 700 flexplates.

- Measure the flexplate flatness at the converter mounting bolt hole diameter. Limit: 0.020 inch (0.51 mm) T.I.R. maximum.
- Measure the converter axial location. Limits: 3.413–3.592 inch (86.69–91.24 mm).

5–2. INSPECTING FLEXPLATE DRIVE ASSEMBLY (ENGINE-MOUNTED MODELS)

- Inspect the flexplate. Replace it if worn or damaged. Examine the flexplate for pitting, cracks, distortion, and elongated bolt holes.
- Measure the engine crankshaft end play. It **must be** within the limits prescribed by the engine manufacturer.
- Measure the concentricity of the engine crankshaft hub with the flywheel housing. Refer to engine specifications for runout limits
- Install the flexplate assembly onto the engine crankshaft, using the bolts and torque specifications prescribed by the engine or vehicle manufacturer. Refer to Figure 3–1 for the proper position of the installed flexplate.

5–3. INSPECTING INPUT DRIVE COMPONENTS (REMOTE-MOUNTED MODELS)

- Inspect shaft condition. The shaft **must not** be dented or bent. Welds must be sound.
- Remove any accumulation of grease and dirt.
- Inspect universal joints, yokes, coupling flanges, and slip-joint splines for wear or damage.
- Driveline angles—runout, or balance which does not conform to the manufacturer's recommendations
- Lubricate universal joints and slip joints, using the vehicle manufacturer's recommendation for lubricants.

CAUTION: Misindexing of the driveline can cause failure of the transmission.

- Inspect driveline universal joints or slip joints for indexing to conform to vehicle manufacturer's specifications.

5–4. INSPECTING CHASSIS DRIVELINE

Inspect the chassis and driveline components for the following conditions and correct as necessary:

- Broken or worn transmission mounts.
- Worn or missing isolators (rubber mounts).

- Improper or damaged bolts, hardware.
- Cross-frame members, rear-support members.
- Front mounting spaces (some installations have spacers to adapt narrow converter housing mounts to wider mountings on frame).
- Driveline midship or hanger bearings.
- Driveline yoke slip joints for freedom of movement, wear, lubrication, and indexing.
- Driveline angles, universal joint indexing, runout and balance for conformance to manufacturer's recommendations.
- Auxiliary transmission or transfer case mountings, alignment, flanges or yokes, backlash, and fluid leaks.
- PTO driven equipment, shafts, and couplings for condition and alignment.

5–5. COOLER, FILTER, AND LINES

Inspect the chassis and driveline components for the following conditions and correct as necessary:

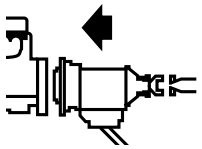
- Cooler (heat exchanger)—clean, flush, or replace if cleaning and flushing are not satisfactory.
- Cooler connecting lines—clean and flush; inspect for deterioration, faulty connectors, kinks, and leaks.
- All lines and fittings for accumulated dirt and grease—clean lines and fittings.
- All lines for chafing, heat deterioration, and proper routing—replace lines with high temperature lines, as required, to provide fluid-tight systems.
- O-rings on fittings—replace O-rings (use Viton® O-rings).
- External filter—replace filter element.
- Filter lines—clean and flush; inspect for deterioration, faulty connectors, kinks.
- Refer to Paragraphs 2–9 and 2–10 for additional information.

5–6. INSPECTING CONTROLS

a. Inspection. Inspect the transmission control components on the vehicle for the following and correct as necessary:

- Shift selector control for freedom of movement, frayed or kinked cables, lubrication, worn rod ends or clevis pins, damaged threads, and proper routing.

- Mechanical modulator control for freedom of movement, frayed or kinked cables, lubrication, worn rod ends or clevis pins, damaged threads, and proper routing.
- Parking brake control for cracks, bends, damaged threads, worn rod ends and clevis pins.
- PTO control for damage, wear, proper operation, and lubrication.
- Hydraulic retarder control for damage, wear, frayed or kinked cable, worn rod ends and clevis pins, cotter pins, lubrication, and proper operation.
- Speedometer drive cable for wear, damage, kinks, lubrication, and proper routing.
- Wiring and related electrical components of signals, sensors or switches for poor connections, frayed wiring, and damage.
- Capillary tubes or sensors for temperature gauges.
- Fluid pressure gauge tubing for damage, kinks, and proper routing.

Section VI	INSTALLING TRANSMISSION INTO VEHICLE	

6–1. HANDLING

- Handle the transmission carefully to prevent damage to the transmission and components in the vicinity of the installation path.
- Be sure that the bottom of the transmission pan is not bent inward. This can cause the pan to come in contact with the internal suction screen resulting in starvation of the transmission charging pump.
- Use a hoist or transmission jack that permits precise control of transmission movements during installation.

6–2. MOUNTING TO ENGINE (ENGINE-MOUNTED MODELS)

1. Align one of the twelve bolt holes in the flexplate assembly with the access opening at the front of the engine flywheel housing.
2. Install a headless $^{1}/_{2}$–20 guide bolt into one of the flexplate bolt holes in the flywheel (refer to Figure 3–1). Align the guide bolt with the flexplate hole at the access opening.
3. Lubricate the center pilot boss with molybdenum disulfide grease.
4. Push the transmission toward the engine while guiding the pilot boss on the flywheel into the flexplate hub (adapter), and the guide bolt into a hole in the flexplate.
5. Seat the transmission squarely against the engine flywheel housing. No force is required—if interference is encountered, move the transmission away from the engine and investigate the cause.

CAUTION: The converter housing must be flush against the engine flywheel housing before tightening any bolts. Do not use the bolts to seat the housing.

CAUTION: Do not tighten any flywheel bolts until all of the bolts have been installed finger tight

6. Align the bolt holes in the converter housing with those in the engine flywheel housing. Install all of the bolts, finger tight, that attach the transmission to the engine.

7. Tighten four bolts at 90 degree intervals around the converter housing bolt circle. Then tighten the remaining bolts. Use the torque recommended by the vehicle or engine manufacturer.
8. Remove the guide bolt through the access opening in the engine flywheel housing. Replace it with a $^1/_2$-20 x 1 inch self-locking bolt. Tighten the bolt finger tight at this time.
9. While rotating the engine crankshaft, install the eleven remaining $^1/_2$-20 x 1 inch self-locking bolts into the flywheel, finger tight. When all bolts are in place, tighten them to 96–115 lb ft (131–156 N·m).
10. Install the flywheel housing access cover.

6–3. INSTALLING MOUNTING COMPONENTS

1. Install all bolts, washers, spacers, isolators, supports, or cross members required to support the transmission in the vehicle frame.

CAUTION: Use the type and grade of mounting bolts recommended by the vehicle manufacturer. The $^5/_8$-11 bolts in the converter housing must have at least 32 mm ($1^1/_4$ inches) thread engagement. The $^3/_4$-10 bolts in the rear adapter housing must have at least 38 mm ($1^1/_2$ inches) thread engagement, but must not bottom in the adapter housing.

2. Tighten the bolts to the torque recommended by the vehicle manufacturer.

6–4. COUPLING TO ENGINE (REMOTE-MOUNTED MODELS)

1. Install (if removed) the input drive shaft components that connect the engine and transmission.
2. Couple the flange or yoke to the flange or yoke at the front of the transmission. Use the bolts and torque recommended by the vehicle manufacturer.
3. Compare the alignment of the transmission with the engine against the vehicle manufacturer's specifications.

6–5. COUPLING TO DRIVELINE

1. Couple the driveline companion flange or universal joint yoke to the flange or yoke on the transmission. Use the bolts and torque recommended by the vehicle manufacturer.
2. Measure the universal joint angularities (all joints in driveline) to determine if they are within the specifications of the vehicle manufacturer.

6–6. CONNECTING COOLER AND FILTER LINES

Figure 6–1 through Figure 6–5 illustrate the different filter and cooler connection configurations.

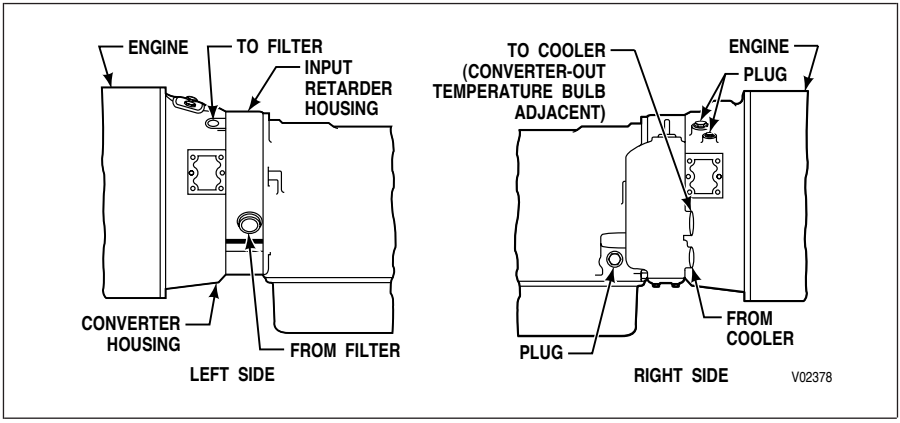


Figure 6–1. Earlier Cooler and Filter Connections—Without Engine-Driven PTO and With Input Retarder

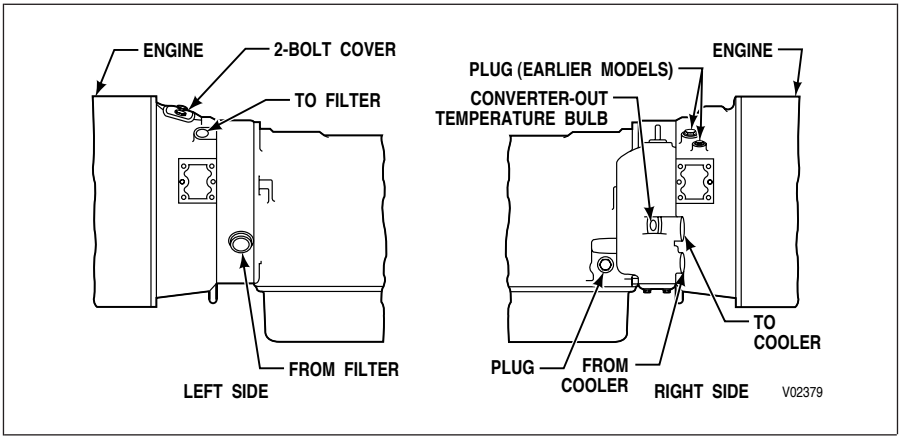


Figure 6–2. Cooler and Filter Connections—Without Engine-Driven PTO and With Input Retarder

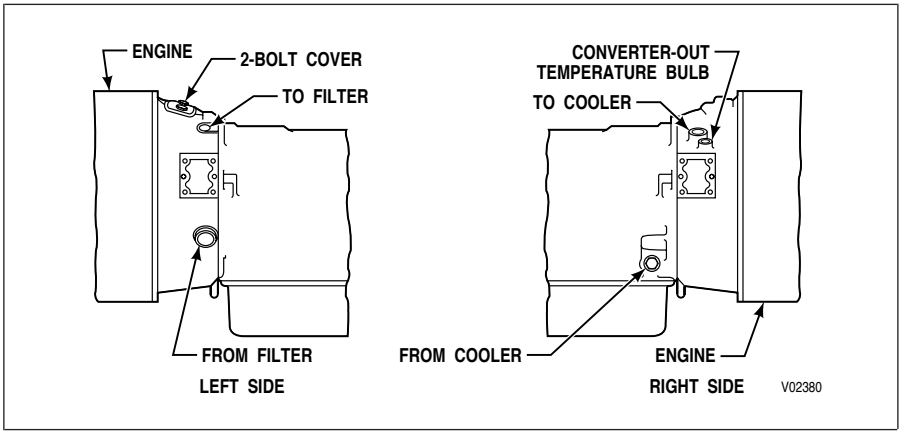


Figure 6–3. Cooler and Filter Connections—Without Engine-Driven PTO and Without Input Retarder

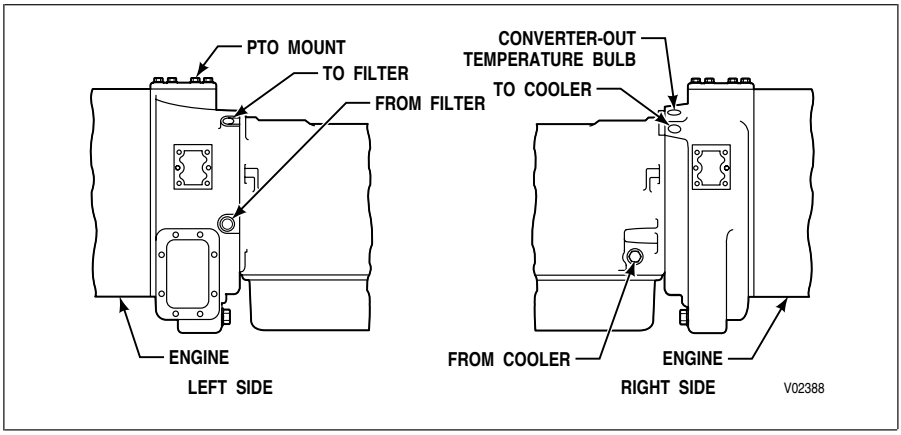


Figure 6–4. Cooler and Filter Connections—With Engine-Driven PTO and Without Input Retarder

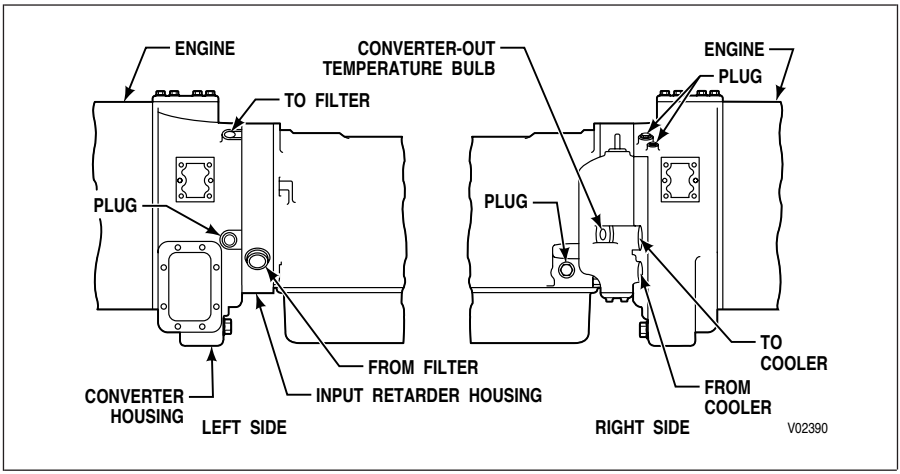


Figure 6–5. Cooler and Filter Connections—With Engine-Driven PTO and Input Retarder

1. Connect the external filter and cooler lines to the transmission. Avoid kinks, sharp bends, twists, and contact with components that will chafe the hydraulic lines.
2. Determine proximity to manifolds or exhaust pipes. Excessive heat will hasten the deterioration of hydraulic lines.
3. Be sure all lines are proper size and type recommended. Use new Viton® O-ring seals where required. Replace any non-Viton® O-rings, regardless of their condition.
4. Tighten the line fittings on the transmission to 50–60 lb ft (68–81 N·m).

6–7. CONNECTING SHIFT SELECTOR CONTROL

Proper shift selector adjustment is critical. Improper linkage adjustment can cause metering of clutch apply fluid, resulting in clutch slippage. The position of the selector lever (refer to Figure 6–6) directly affects the position of the selector valve. When the adjustment is correctly made, the linkage to the selector lever retainer pin should move freely.

When there is no free pin movement, it is recommended that the linkage be adjusted as follows:

1. At the driver's position, place shift lever in the **R** (Reverse) position.
2. At the transmission, rotate the selector lever to the **R** (Reverse) position.

LEVER POSITION	RANGE				
	FIG. 1	FIG. 2		OPT. 1	OPT. 2
	HT 740 HT 747	HT 754 CR	HT 750 DR	CT 700 SERIES	
D1	1	1	1	1	1
D2	1–2	1–2	2	2	1–2
D3	1–3	1–3	2–3	2–3	1–3
D4	1–4	1–4	2–4	2–4	1–4
D5	–	1–5	2–5	2–5	1–5
N	N	N	N	N	N
R	R	R	R	R	R

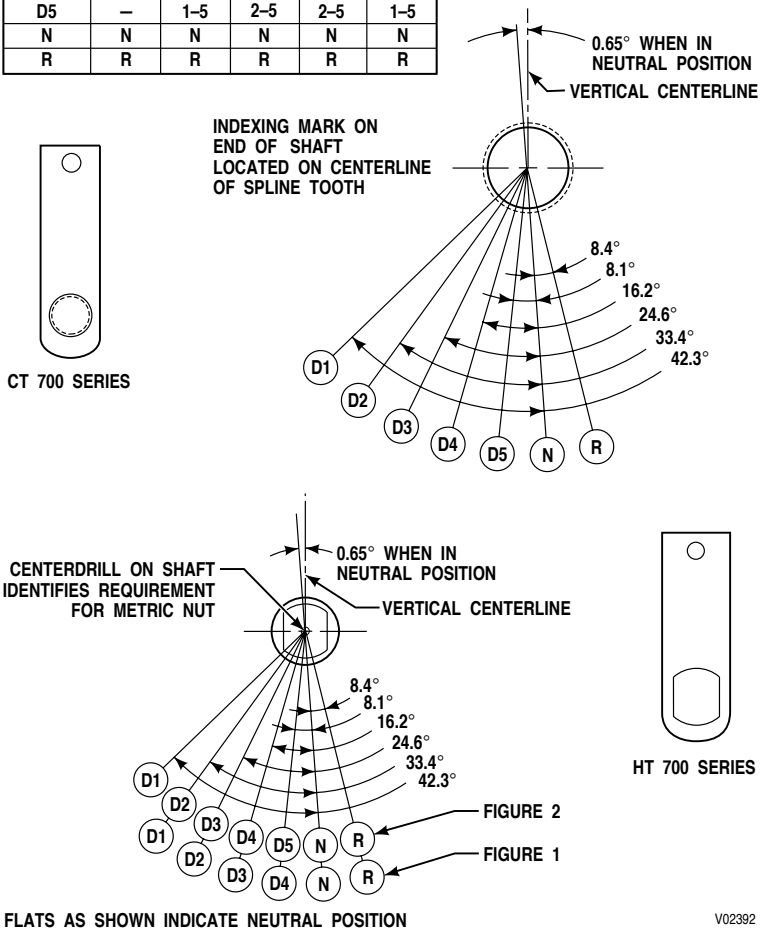


Figure 6–6. Shift Selector Positions

3. Align the linkage connector pin to the selector lever. Adjust the linkage if necessary to obtain a free pin.
4. Do the same procedure again, except this time begin with the driver's shift selector in the first position.

5. Start the engine and move the shift selector to **D** (Drive). Slowly move the shift selector toward **N** (Neutral). Clutch release or engine rpm increase should be felt before the lever reaches the **N** (Neutral) slot.
6. Move the lever to the **R** (Reverse) position; then slowly move the shift selector toward **N** (Neutral). Clutch release or an engine rpm increase should be felt before the selector reaches the **N** (Neutral) slot.

NOTE: For installation of dual-mode shifting or other options, refer to vehicle service manual and to Preventive Maintenance—Oil Field Applications PM1772EN.

6–8. CONNECTING HYDRAULIC INPUT RETARDER CONTROL

1. Place the operator's control at the OFF (disengaged) position.
2. Inspect the hydraulic retarder control valve. The valve is spring-loaded to retract into the valve body when the retarder is OFF. Lift the valve upward, to the ON position, to determine the full travel distance—1.5 inches (38 mm) from OFF to ON position.
3. Release the valve, permitting the spring to retract the valve.
4. Adjust the linkage so that the rod end or the clevis registers with the pin hole in the retarder valve. Connect the linkage to the retarder valve, and inspect the operation of the valve. The valve **must be** fully extended when the operator's control is at ON; the valve **must be** fully retracted when the control is at OFF.

CAUTION: Failure to obtain a full OFF stroke will result in low vehicle power and transmission overheating. Failure to obtain a full ON stroke will result in less than rated retarder performance (no retarder complaint).

6–9. CONNECTING MODULATOR CONTROL

1. Connect the engine (throttle) end of the modulator cable housing to its mounting.
2. Open the engine throttle fully and determine whether the throttle linkage will push or pull (refer to Figure 6–7) the cable core when the throttle linkage is moving toward full-throttle position. If it will push the cable core, then push the cable core until it reaches the end of its travel. If movement of the throttle linkage toward full-throttle position will pull the cable, then pull the cable to the end of its travel.

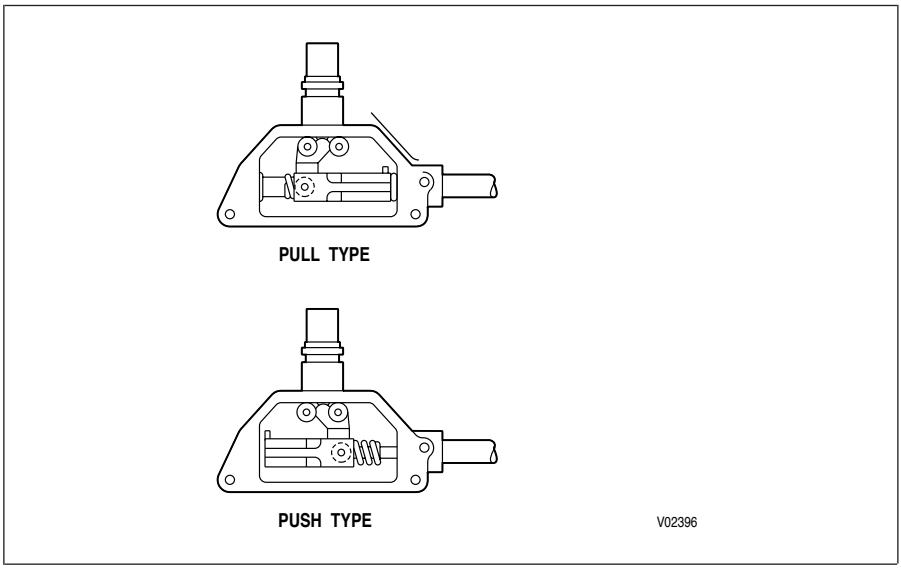


Figure 6–7. Current Mechanical Modulators

3. Adjust the clevis or rod on the cable core until it registers with the hole in the throttle linkage lever, and the connecting pin can be freely inserted. With the pin removed, rotate the clevis or rod end one additional turn counterclockwise (viewing cable core from its end) for pull-type arrangement, or one additional turn clockwise for push-type arrangement. This will make sure that the modulator does not prevent the throttle lever from reaching the full ON position. Install the clevis pin or rod end to connect the throttle linkage and cable. Tighten the locknut against the clevis or rod end.
4. Confirm the travel of the cable core when the throttle is moved from the fully open to fully closed position. The system is designed to provide a minimum travel of 1.187 inch (30.15 mm), and a maximum of 1.56 inch (39.6 mm).
5. Various kinds of modulator controls may be used, but the object of each is to apply increasing force to the modulator actuator rod as the engine fuel control is moved from closed to open position. The most common type of control is the cable-operated mechanical actuator with a lever to vary the force on the modulator valve. The modulator can usually be converted to use either push or pull force on the cable when the throttle is opened. Make sure the modulator controls, when connected to the throttle linkage, provide an increasing force against the modulator actuator rod in the transmission when the engine throttle is moved toward the open throttle position.

6. Current actuators include a lever that is marked PUSH on one side, and PULL on the opposite side. When the modulator control cover is removed, the word PUSH or PULL can be seen and will indicate how the device is assembled.
7. Earlier mechanical actuators include a sliding cam (wedge) (refer to Figure 6–8). When the cover is removed, the position of the cam can be seen. When the smaller end of the cam is toward the cable housing, the device is the pull type. When the larger end of the cam is toward the cable housing, the device is the push type.

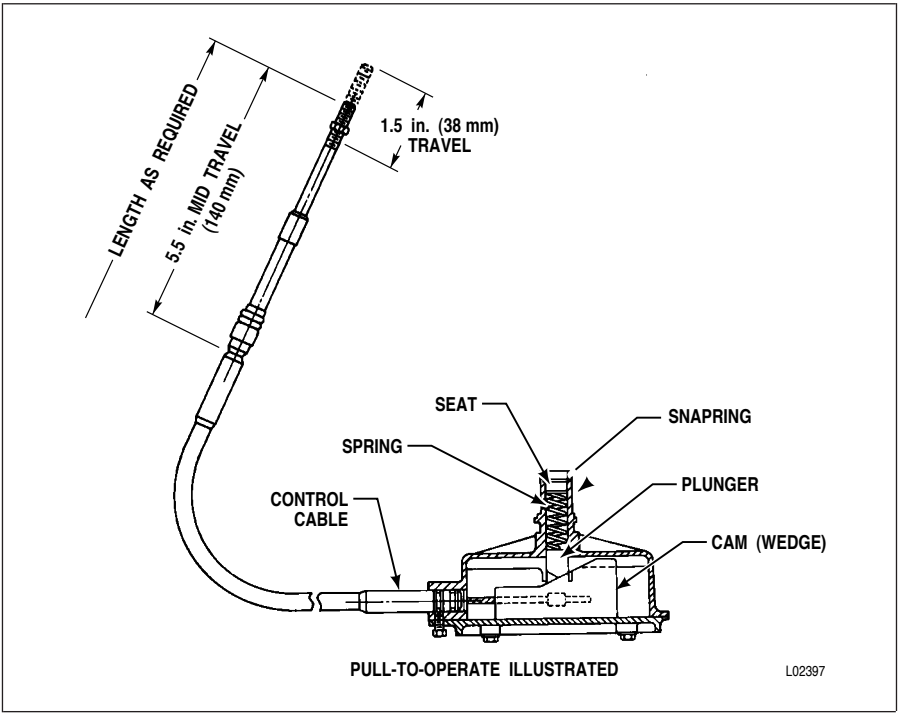


Figure 6–8. Earlier Style Mechanical Modulator

8. The conversion of either the lever or cam type to the opposite mode of operation requires the internal parts to be reassembled. Reverse the positions of the lever, spring, and thimble in the lever type to convert it (refer to Figure 6–7). Reverse the cam in the cam type to convert it.
9. Be sure the modulator control action is as required.
10. Install the O-ring seal onto the modulator control. Coat the O-ring with oil-soluble grease.

11. For earlier models (refer to Figure 6–9), install the modulator actuator rod into the modulator valve body, through the modulator mounting hole in the transmission housing.

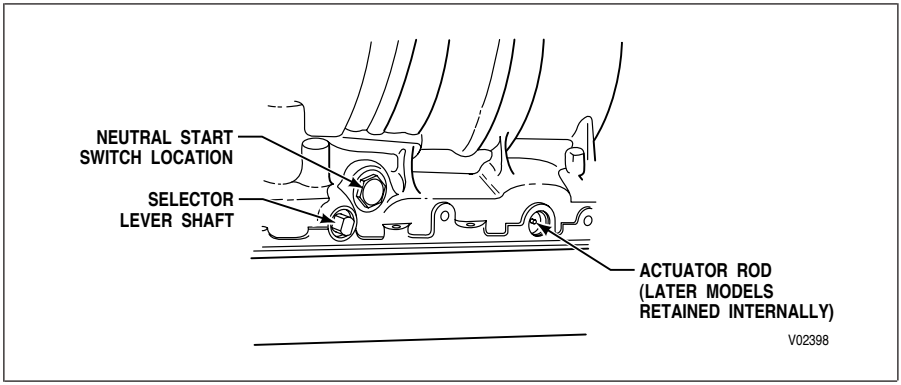


Figure 6–9. Connector Locations—Left Side

CAUTION: If the modulator actuator rod is omitted or falls into the pan during modulator installation (earlier models), the result will be excessive modulator pressure which will cause the lockup clutch to engage and stall the engine.

12. Install the modulator control into the transmission. Attach the control housing with the spring clip and the $^{5}/_{16}$-18 x $^{3}/_{4}$ inch bolt provided. The convex side of the formed end of the clip must be toward the transmission, and against the shoulder of the actuator stem. Tighten the bolt to 13–16 lb ft (18–22 N·m).
13. Confirm the cable routing. Bends **must not** be of less than 200 mm (8 inches) radius. Avoid "S" bends. The cable **must not** be nearer than 6 inches (150 mm) to the engine exhaust pipe or manifold. The cable **must follow** the movements of the throttle linkage. It may be necessary to add a spring to make sure that the movement occurs smoothly.
14. Adjust other types of modulator controls as recommended by the vehicle manufacturer.
15. The cable routing should avoid proximity with heat source such as exhaust manifolds, mufflers, tailpipes, etc.
16. Normal modulator cables will withstand continuous temperatures of 250°F (120°C). Insulation, heat shields, or mechanical linkage actuation may be necessary if 250°F (120°C) is exceeded.

6–10. CONNECTING POWER TAKEOFF (PTO) CONTROLS

1. If not previously installed, mount the PTO on the transmission. Refer to Paragraph 4–5 for instructions.
2. Connect controls to the PTO. Test for proper operation of the controls.
3. Inspect cable or linkage rod routing. Kinks, sharp bends, and proximity of the cable to exhaust pipes or manifold **must be** avoided. Rods or linkage **must not** rub or interfere with adjacent parts.

CAUTION: PTOs using main transmission hydraulic pressure to apply the PTO MUST HAVE main pressure dead-headed at the valve when not in use.

4. Couple the PTO output to its driven equipment. Inspect couplings or universal joints for proper assembly and alignment.

6–11. CONNECTING PARKING BRAKE CONTROL

1. Connect and properly adjust the parking brake linkage.
2. Adjust the brake shoe-to-drum clearance as specified by the manufacturer.

6–12. CONNECTING OUTPUT DISCONNECT SHAFT CONTROLS (DROPBOX)

1. Connect and adjust the output disconnect shaft linkage.
2. If a manual actuator is used, adjust the linkage to give a crisp detent at the engaged and disengaged positions—approximately 1.06 inch (26.9 mm).
3. If an air actuator is used, the stroke of the cylinder **must be** controlled to give a crisp detent at the engaged and disengaged positions.
4. Be sure there is no force applied to the shifter shaft when in the fully engaged or disengaged position.

6–13. CONNECTING SPEEDOMETER DRIVE

1. Install the speedometer driven gear assembly into the transmission. Tighten the body in the transmission rear cover to 45–50 lb ft (61–68 N·m). If no speedometer drive is provided, be sure the plug is installed to close the hole in the housing (torque is same as for driven gear body).
2. Install the speedometer drive cable onto the driven gear assembly. Tighten the nut to 50 lb in. (5.65 N·m). Avoid kinks or sharp bends in the cable assembly. All bends must have a radius of 6 inches (150 mm) or more. No more than one 90 degree bend is allowed.

6–14. INSTALLING TEMPERATURE AND PRESSURE SENSORS, ELECTRICAL COMPONENTS

1. Install temperature sensors (capillary tube and bulb or thermocouple) into the converter housing or hydraulic input retarder valve.
2. Refer to Figure 6–1 through Figure 6–5 for various locations. Tighten the $^1/_2$ inch pipe thread adapter sufficiently to prevent leakage.
3. Install the bulb into the adapter and tighten the nut into the adapter.
4. Be sure the capillary tube does not interfere with parts that might chafe or damage the tube. Long tubes may require clips or brackets for support.
5. Install electrical temperature sensors into the proper openings (refer to Figure 6–1 through Figure 6–5). Connect electrical leads to the sensors
6. Be sure that all openings in hydraulic input retarder models that require plugs are plugged (refer to Figure 6–1 through Figure 6–5).

NOTE: The type and location of the neutral-start switch is optional. A threaded opening in the left side of the transmission can be used for installation, if desired (refer to Figure 6–9).

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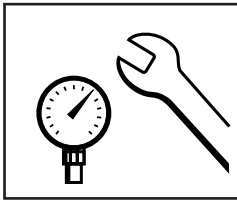
7. Install the neutral start switch (if so equipped) into the left side of the transmission housing (refer to Figure 6–9). The switch must include an aluminum washer (gasket) approximately 0.090 inch (2.29 mm) thick for earlier models and 0.030 inch (0.76 mm) thick for later models. Tighten the switch to 50–60 lb ft (68–81 N·m).
8. Connect the wire leads that serve the neutral start switch
9. If the neutral start switch is not mounted at this location, the opening **must be** plugged. The plug seats on a rubber-coated washer.
10. If so equipped, install the reverse signal switch at the right side of the transmission housing. Tighten the switch to 48–60 lb in. (5.5–6.7 N·m). Connect the electrical leads.
11. Install and connect other electrical components such as heaters, winterization equipment, and pressure sensors.
12. Install the pressure gauge tubes, if so equipped.
13. Test the starting circuit. The starter should operate only when the transmission shift selector is in the **N** (Neutral) position.

6–15. FILLING THE HYDRAULIC SYSTEM

1. Be sure the hydraulic system is properly filled before starting the engine. Refer to Section II, Preventive Maintenance, for capacity information (Section II–4c) and cold and hot test procedures (Section II–4d and e).
2. Keep transmission fluid clean.



TESTS AND ADJUSTMENTS

Section VII

7–1. ENGINE, TRANSMISSION ADAPTATION REQUIREMENTS

- Refer to Operator's Manual OM1334EN or OM1475EN for instructions.
- Test the neutral start circuit by trying to actuate the starter at all selector positions. The starter should operate only when the transmission is in **N** (Neutral).
- Test the position of the operator's selector lever in each drive range and neutral. The lever should align with the mark indicating a range (or neutral) when the transmission is in that range (or neutral).
- Drive the vehicle to determine if the transmission is functioning properly. The test drive should include a variety of conditions and terrain that will reveal any deficiency in the transmission operation, or need for adjustment.
- Inspect the instruments that are associated with the transmission. These include the speedometer and the transmission temperature gauge.
- Apply and release the parking brake. Make sure it is not dragging or heating up while the vehicle is traveling.
- Operate the PTO. Refer to the Operator's Manual for general operating instructions, or to the vehicle manufacturer's specific instructions.
- Determine the no-load governed speed of the engine. Adjust the governor, if necessary, to meet the no-load governed speed specified for your particular engine-transmission match (available from vehicle manufacturer).
- Operate the hydraulic input retarder while descending a grade or slowing on a level road.
- Operate a stationary vehicle's input retarder by revving the engine to full no-load govern speed in neutral and applying the retarder. Note the engine speed will drop significantly.
- To test shift points, refer to Service Manual SM1270EN or SM1314EN for proper procedure.

7–2. INSPECTING FLEXPLATE DRIVE ASSEMBLY (ENGINE-MOUNTED MODELS)

Use this list after transmission installation. As items are tested or inspected, mark them off this list.

- **Proper Torque**
  - — Flexplate bolts—96–115 lb ft (130–156 N·m)
  - — Transmission-to-engine bolts—54–65 lb ft (73–88 N·m)
  - — Transmission-to-frame or mounting bolts—164–192 lb ft (222–260 N·m)
  - — Output flange nut—600–800 lb ft (813–1085 N·m)
  - — Companion flange or universal joint bolts (tighten to vehicle manufacturer's recommendations)
  - — Manual selector lever nut—15–20 lb ft (20–27 N·m)
  - — PTO mounting bolts—38–50 lb ft (52–68 N·m)
  - — Modulator control retaining bolt—15–20 lb ft (20–27 N·m)
  - — Hydraulic line fittings in transmission housing—40–50 lb ft (54–68 N·m)
  - — Fill tube nut—90–100 lb ft (122–136 N·m)
  - — Speedometer body in rear cover—40–50 lb ft (54–68 N·m)
  - — Speedometer drive cable nut—50 lb in. (6.0 N·m)
  - — Neutral start switch to transmission—50–60 lb ft (68–81 N·m)
  - — Reverse signal switch to transmission—4–5 lb ft (5.42–6.78 N·m)
  - — Parking brake bolts to transmission—164–192 lb ft (222–260 N·m)
  - — Input flange nut—450–550 lb ft (610–745 N·m)
  - — Fluid temperature sensor—16–20 lb ft (22–27 N·m)
- **Fluid Cooler, External Filter Lines**
  - — Inspect for leaks
  - — Test for tightness of connections
  - — Inspect routing
- **Linkage**

  a. Manual selector valve
  - — Adjustment (at all positions)
  - — Ease of movement
  - — Neutral safety switch (start only in neutral)
  - — Shift selector (for freedom of operation)

b. Mechanical modulator control
   — Adjustment
   — Ease of operation
   — Routing

c. Parking brake
   — Adjust for proper clearance
   — Adjust for full apply
   — Check for full release

d. Hydraulic input retarder
   — Adjustment (full open, closed)
   — Ease of operation

- **Drive Line**
  — Inspect for proper indexing of universal joints
  — Inspect for proper driveshaft angles
  — Determine differential backlash
  — Lubricate universals and slip-joints
- **Hydraulic system**
  — Recommended fluid (refer to Paragraph 2–6)
  — Sufficient fluid in transmission
  — Dipstick properly marked
  — Fill cap tight
  — Fill tube tight at oil pan
  — Breather clean, free of restriction
  — Look for fluid leaks during operation
- **Power Takeoff**
  — Backlash properly established
  — Controls connected and operative
  — Properly coupled to driven equipment
- **Instruments and Electrical Equipment**
  — Speedometer
  — Fluid temperature gauge
  — Wiring and electrical connections
  — Reverse signal switch
  — Neutral-start switch

Section VIII	CUSTOMER SERVICE	

8–1. OWNER ASSISTANCE

There are distributors and dealers around the world ready to stand behind every Allison Transmission product. Any situation that arises in connection with the sale, operation, or service of your transmission will be handled by the distributor or dealer in your area.

Refer to the Worldwide Sales and Service Directory SA2229EN for a current listing of Allison Transmission authorized distributors and service dealers.

8–2. SERVICE LITERATURE

Additional service literature is available as shown in the following table. This service literature provides fully illustrated instructions for the operation, maintenance, service, overhaul, and parts support of your transmission. To be sure that you receive maximum performance and service life from your transmission, you may order publications from:

SGI Inc.
Attn: Allison Literature Fulfillment Desk
8350 Allison Avenue
Indianapolis, IN 46268
TOLL FREE: 888–666–5799
INTERNATIONAL: 317–471–4995

Table 8–1. Available Service Literature

	HT 740, 740FS, 747, 754CR, 750DR, 750DR (DB)	CT, CLT, CLBT, 750, 754 (DB)
Operator's Manual *	OM1334EN	OM1475EN OM1772EN**
Service Manual	SM1270EN	SM1314EN
Parts Catalog* Parts Catalog CD-ROM	PC1268EN CD1268EN	PC1315EN CD1315EN
Technician's Guide/Inspection Analysis	GN2033EN	GN2033EN
Troubleshooting Manual	TS1838EN	N/A
Worldwide Sales and Service Directory*	SA2229EN	SA2229EN

* Also available on the internet at *www.allisontransmission.com*

** Preventive Maintenance Oil Field Applications

MT1366EN 200604 www.allisontransmission.com Printed in USA 200606